favored size for intense local flux tubes with $V_t - c_s$ is just $L(V_t/c_s)^2$ and we expect there to be roughly $(c_s/V_t)^2$ of them per turbulent cell. Each flux tube will be surrounded by a local turbulent wake of size $r_t$ and a large-scale eddy velocity of $V_t$. This implies that different parts of the tube will tend to diffuse out to a radius at which the turbulent drift is just balanced by attractive effects due to the winding up of the magnetic flux tube. This radius turns out to be $L(V_t/c_s)^2$ so these flux tubes are relatively stable structures. A similar argument, applied to larger-scale, correlated assemblages of such flux tubes, implies that on a scale $R$ one expects to find $(V_t/V_\Phi)^2$ flux tubes, of strength $V_\Phi = V_t(R/L)^{1/2}$.

How quickly will a single flux tube rise? Each flux tube will feel an upward acceleration of $g$, the local gravity, since each will be significantly underdense relative to the surrounding medium. They will tend to drift upward as fast as allowed by their coupling to the surrounding turbulent medium. Since each is embedded in a local wake with local eddy speed of $V_t$, and since the buoyant upward rise is slow compared to $V_t$, we have

$$V_t(V_t/r_t) \sim g$$

or

$$V_t \sim r_t g / V_t \sim L_t (V_t / c_s)^{-1}.$$  

In other words, the tiny flux tubes rise at the speed one would have obtained for the diffuse field. For an accretion disk $L \sim V_\Phi \Omega$, $g \sim H_c c_s \sim H_\Sigma$, and $V_t \sim V_\Phi$, where $H$ is the disk thickness and $\Omega$ is the local Keplerian frequency. Consequently one predicts that magnetic flux is lost from the disk at a rate of $V_\Phi^2/(c_s H)$, in accord with previous estimates based on the assumption of a diffuse field.

In spite of this lack of obvious effect the existence of these small flux tubes turns out to be important for two reasons. First, the separation of magnetized and unmagnetized volumes in the plasma allows us to see how highly conducting dense plasmas can apparently violate the flux-freezing condition and allow nearly independent motion of the magnetic field and the bulk of the fluid. This in turn allows for the possibility of turbulent diffusion and effective dynamo action. This point is extremely important given that recent work in two-dimensional turbulence has cast doubt on the possibility of reconciling dynamo action with flux-freezing [3]. (We note in passing that in two dimensions the formation of flux tubes does not allow large-scale relative motions between the fluid and the magnetic field due to topological constraints.) Second, in radiation-pressure-dominated environments the diffusion of photons into flux tubes will prevent the magnetic field pressure from ever dominating even small volumes in the plasma. This implies large and weak flux tubes that, if effectively evacuated of matter, will be much more buoyant than a diffuse field would be. Consequently the magnetic dynamo in a radiation-pressure-dominated disk will saturate at a lower level, giving rise to a smaller effective viscosity.

References:
lines. These observations suggest that the annihilation region must be deep in the gravitational potential, but cannot be at the site of the positron production. This suggests that electron-positron pair winds may play a role in transporting the positrons from the site of production to that of annihilation [2]. The suggestion that there are quasi-steady-state flows from within the inner disk in turn suggests that the site of the origin of the hard power law radiation may be the same as that of the positrons, but that it is not a static corona, but rather associated with a steady flow from the inner disk.

Another special aspect of the BHXN is that two of them, V 404 Cyg and A0620-00, have revealed enhancements in Li in the atmosphere of the dwarf companion. This is also seen in Cen X-4, a neutron star transient, so the Li is not a unique signature of black hole systems. Nevertheless, the Li represents an important clue to the evolution of the system and to the physical processes that occur there. Two interesting possibilities are spallation in the disk or the companion star requiring energetic particles, or a precursor phase with a Thorne-Zytkow object, a buried neutron star in which the deep hot-bottom convective envelope may generate Li and mix it to the surface.